A Higher Level of Performance

Manual

Gladiator

Gen 3 Microwave Switch Series

Beam Blockage Detection

Circular Polarisation

For more information, please visit >

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Contents

Overview 3
Principle of Operation 3
Typical Uses 3
Function 3
Features 3

Dimensions 4
Remote Microwave System 4
Weldments and Windows (UHMW / PTFE) 5
Weldments and Windows (Ceramic) 6
Weldments and Windows (Ceramic Tile & Firebrick Assemblies) 7

Mounting 9
General Guidelines 9
Mounting With Windowed Weldments 10
Installation With Adjustable Mounting 11
Correct Mounting Angle 12
Align Sender and Receiver 12

Wiring 13
Remote System Connection - HAWK Supplied Cable 13
Remote System Connection - Customer Supplied Cable 14
Alternate cable type between Amplifier and Sensors 14

Functionality Layout - Remote System 15

Wiring 16
Integral System Connection 16

Functionality Layout - Integral System 17

Wiring 18
Wiring - Relay Functions 18

Setup Procedure - Integral System 19

Setup Procedure - Remote System 20

Operational Diagnostics 21

Remote Main Menus & Interface 22
Remote Main Menus & Interface - Remote System 22

Remote Setup Procedure 23
Quickset Menu - Parameters 23
App Type - Parameters 24
Advanced Menu - Parameters 25

Relay 2 Actions 26

Relay 2 Software Flow Chart 27

Cross-Talk Prevention / Sequencer Wiring 28

Integral Test Switch 29
Integral Receiver Test Switch Functions 29

Troubleshooting 30
Error Codes 31

Safety Information 32
FCC Regulations 32

Part Numbering 33
Remote Version 33
Integral Version 34

Specifications 35

PROPRIETARY NOTICE

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WARNING

This instrument contains electronic components that are susceptible to damage by static electricity. Proper handling procedures must be observed during the removal, installation, or handling of internal circuit boards or devices:

Handling Procedure:

1. Power to unit must be removed prior to commencement of any work.
2. Personnel must be grounded, via wrist strap or other safe, suitable means, before any printed circuit board or other internal devices are installed, removed or adjusted.
3. Printed circuit boards must be transported in a conductive bag or other conductive container. Boards must not be removed from protective container until the immediate time of installation. Removed boards must be placed immediately in a protective container for transport, storage, or return to factory.

Principle of Operation

Beam blockage

A beam of microwave energy passes from a sender to a separate receiver in bursts approximately 200 times per second. If the path between the sender and receiver is blocked by any object or material which absorbs or reflects microwave energy, then the receiver will not be able to detect the signal. The presence or absence of the signal at the receiver is used to switch a relay for indication or control purposes.

Microwaves are small (Micro) radio waves transmitted from point to point hence the system setup of 'sender' and 'receiver' units.

Typical Uses

- Blocked chute detection
- Collision detection
- Stacker / Reclaimer protection
- Shiploader protection
- Nucleonic switch replacement
- High level alarm / Low level alarm
- Truck / machine detection.

Function

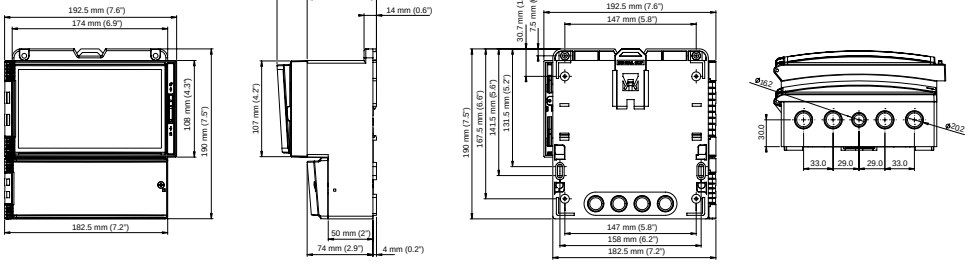
The Gladiator Microwave Switch can be used for blockage detection, barrier detection, machine detection, collision detection for protection, point level measurement, and detection of objects or material between two points.

Features

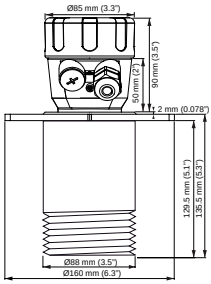
- State of the art Circular transmission
- Backwards compatible with all Gladiator Microwave generations
- LCD push button setup / diagnostics on remote amplifier
- Simple sensitivity adjustment and calibration on Integral system
- Ranges up to 1200 meters (3937ft)
- Simple '1-minute' setup application pre-sets
- Remote sensor or Integral 'all in one' types
- Relay outputs: Integral (1 + failsafe) Remote (2)
- Remote test function
- Adjustable ON and OFF delays (0-20 sec)
- Remote 3G HAWKlink connection option
- Remote amplifier to sensor separation up to 500 meters (1640ft)
- Bright visual status indication on sensors
- Independent housing alignment after mounting sensor.

Remote Microwave System

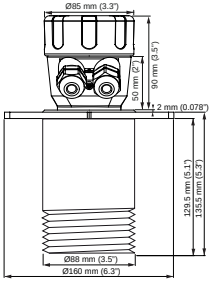
Remote Amplifier



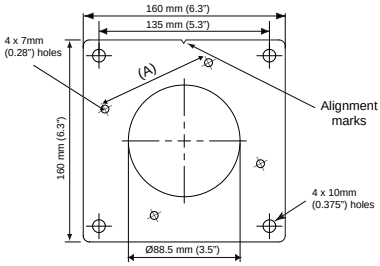
Remote Sender / Receiver



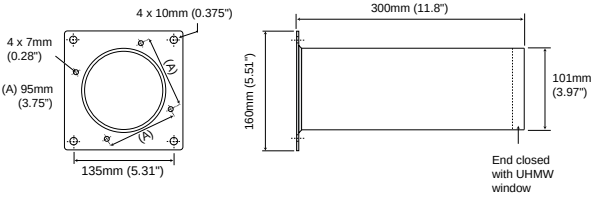
Integral Sender / Receiver



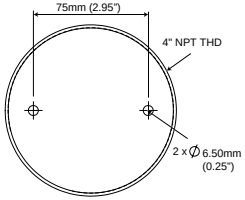
Mounting Bracket



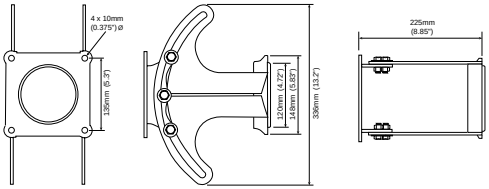
MA15 / MA25 Focaliser Tube (extension pipe)

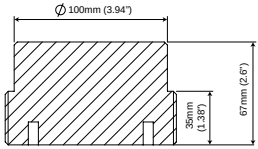


MA20-P1



MA12 / MA13 Adjustable Mounting Bracket

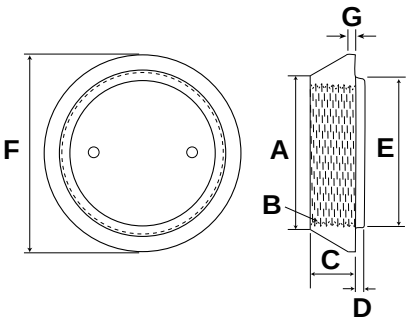




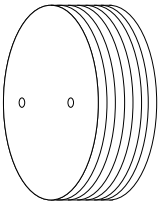
Weldments and Windows (UHMW / PTFE)

Weldment with UHMW / PTFE Windows

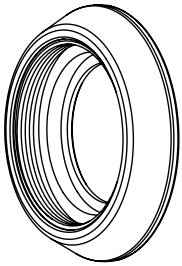
Weldment is welded to the vessel. Window threads into Weldment



Window

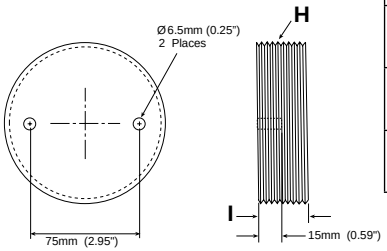


Weldment



Size	A	B	C	D	E	F	G
3”	100 (3.94”)	3” NPT	22 (0.87”)	5 (0.2”)	92.5 (3.64”)	118 (4.65”)	4 (0.16”)
4”	125 (4.92”)	4” NPT	24.4 (0.96”)	5 (0.2”)	120 (4.72”)	148 (5.83”)	4 (0.16”)
6”	190.4 (7.5”)	6” NPT	40 (3.94”)	5 (0.2”)	175 (6.89”)	223 (8.78”)	11.2 (0.44”)

UHMW / PTFE Window



Size	H	I
3”	3” NPT	28.7 (1.13”)
4”	4” NPT	35 (1.38”)
6”	6” NPT	40 (1.57”)

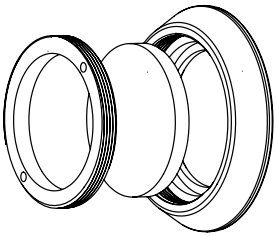
Weldment / Window Parts			
Part Number	**Size**	**Window**	**Weldment**
MA0	3”		✓
MA3	3”	✓	✓
MA4	4”	✓	✓
MA5	6”	✓	✓
MA6	3”	✓	✓
MA7	4”	✓	✓
MA8	6”	✓	✓
MA18	4”		✓
MA19	3”		✓
MA20	4”	✓	
MA21	3”	✓	
MA22	4”		✓

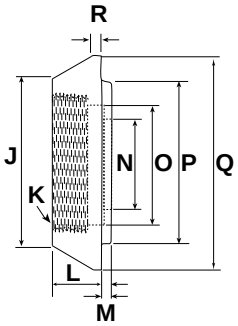
Weldments and Windows (Ceramic)

Weldment with Ceramic Windows

Weldment is welded to the vessel. Window is locked into Weldment with Locking Retainer

Locking Window Weldment Retainer

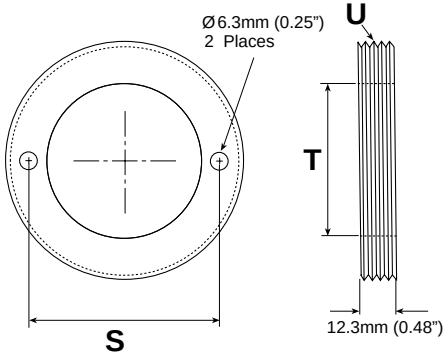




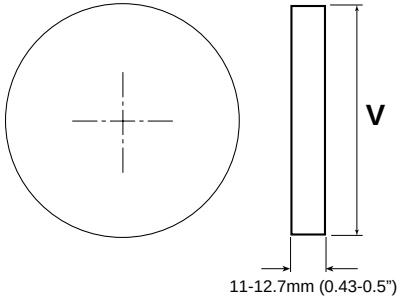
Weldment / Window Parts			
Part Number	**Size**	**Window**	**Weldment**
MA16	3”	✓	✓
MA17	4”	✓	✓

Size	J	K	L	M	N	O	P	Q	R	S	T	U	V
3”	100 (3.94”)	3” NPT	22 (0.87”)	5 (0.2”)	65 (2.56”)	75 (2.95”)	92.5 (3.64”)	118 (4.65”)	4 (0.16”)	75 (2.95”)	65 (2.56”)	3” NPT	74.5 (2.93”)
4”	125 (4.92”)	4” NPT	24.4 (0.96”)	5 (0.2”)	90 (3.54”)	101 (3.98”)	120 (4.72”)	148 (5.83”)	4 (0.16”)	100 (3.94”)	90 (3.54”)	4” NPT	100.5 (3.96”)

Locking Retainer



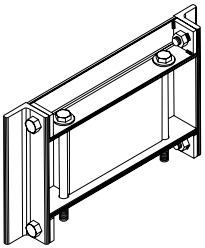
Ceramic Window

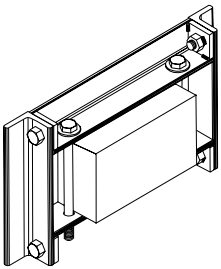


Weldments and Windows (Ceramic Tile & Firebrick Assemblies)

Weldment with Ceramic Windows

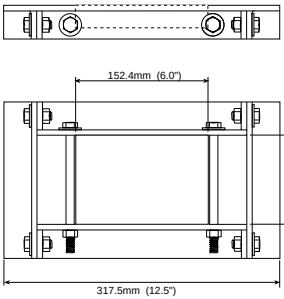
Weldment is welded to the vessel. Window is locked into Weldment with Locking Retainer

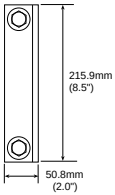




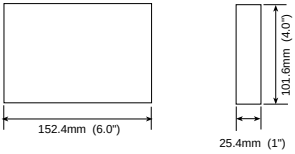
Weldment / Window Parts			
Part Number	**Size**	**Window**	**Weldment**
MA9	Special	✓	✓
MA10	Special	✓	✓
MA16	3”	✓	✓
MA17	4”	✓	✓

Mounting Assemblies

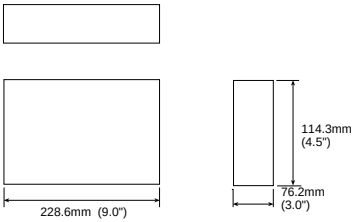




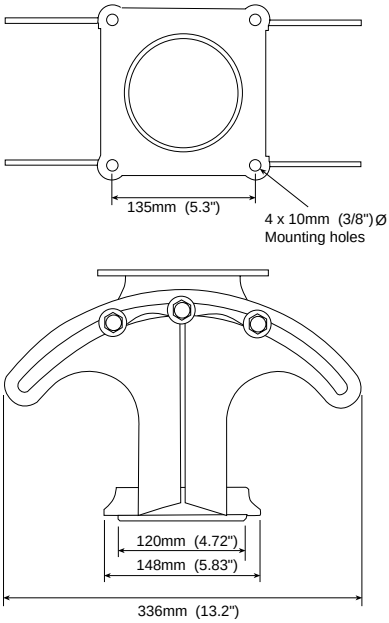
Ceramic Tile



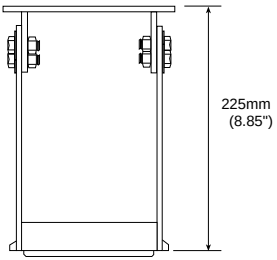
Firebrick



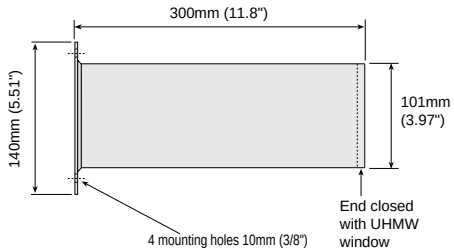
Adjustable Microwave Bracket

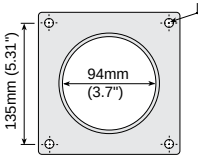


MA-12 - With UHMW Window
MA-13 - With PTFE Window



Flanged Pipe Mount MA-15

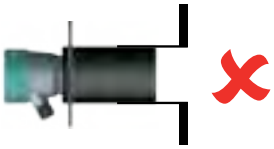




Flanged pipe mount recommended for long range applications

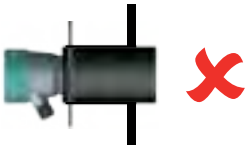
General Guidelines

1. When looking for a mounting location it is important to locate and mount the interior of the window/sensor face for each unit flush with the vessel wall and where minimal build-up will occur. The system can penetrate through generous amounts of buildup of various products, however, the better the position, the more reliably it will operate. A cavity in the vessel mount position where build up is possible will result in a 'plug' forming in front of the beam path resulting in unit performance issues.



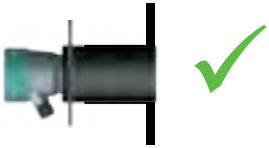
Do not mount with cavity

2. Microwave energy cannot penetrate through steel linings or other conductive linings. You must cut a viewing hole and use an appropriate windowed weldment.



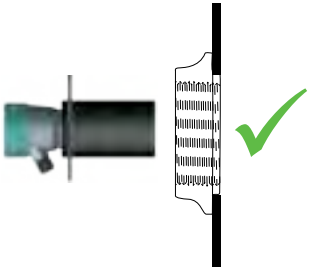
Do not mount where sensor can be damaged by material

3. For high vibration applications, it is necessary to isolate the electronics to keep them from long term damage. This is most often accomplished using 4" UHMW or Teflon windowed weldments in the vessel walls, and mounting the Microwave Sender and Receiver to a separate stable structure (I-beam, handrail) to isolate them from vibration. Isolation shock mounts can also be provided to help protect the electronics.



Mount flush with wall in safe location

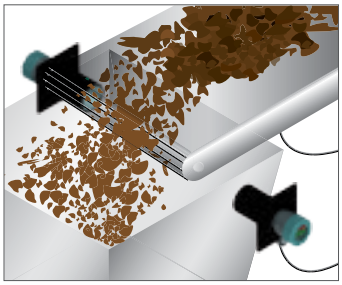
4. For high temperature applications which exceed 65°C/150°F (precipitators, cement cyclones, etc.), it is necessary to ensure that the sensors always remain below 65°C/150°F. This is normally achieved by installation of temperature resistant windows of ceramic or firebrick, and positioning of the Sender and Receiver in line with the windows, and set back far enough that their temperature remains below the given limit.



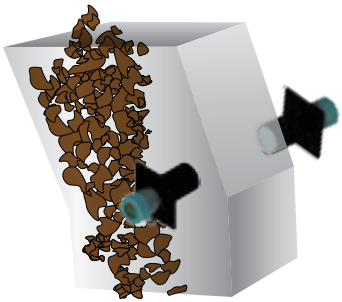
Mount behind flush Window/ Weldments

General Guidelines

4. When **mounting to monitor the level of a flowing product** such as coal, ore or wood chips, position the microwave path out of the direct product flow stream. If at all possible, go behind the flow stream or well in front of it. This will minimise any possibility of unwanted trips due to abnormal product flow blocking the beam. Always use the recommended setup for blocked chute detection.
5. When using the system as a proximity switch such as truck detection the mounting arrangement is application dependent and must ensure proper operation even under worst case conditions.

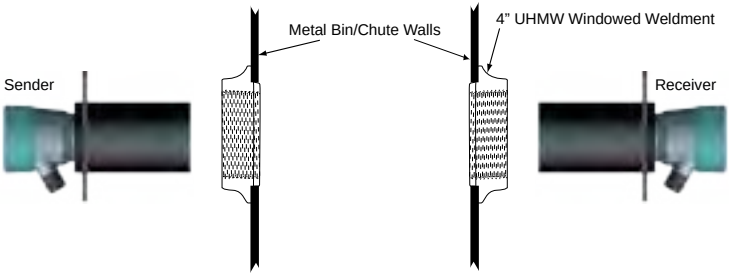


Mount away from main product flow



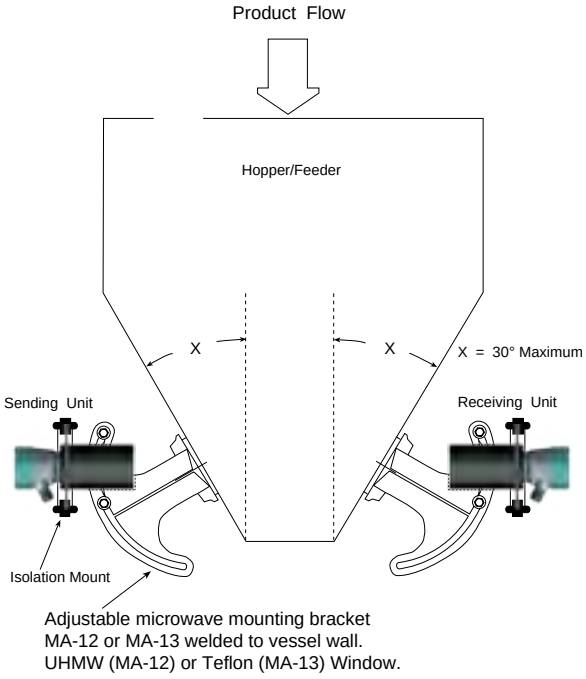
Mounting With Windowed Weldments

Windowed Weldments are designed to protect the Microwave from the hazards of the application. The weldment is welded to the chute/application wall, and then the window is threaded or locked into position. The Microwave pulse will pass through plastics and ceramics. However it will not pass through metallic type lining.



Installation With Adjustable Mounting

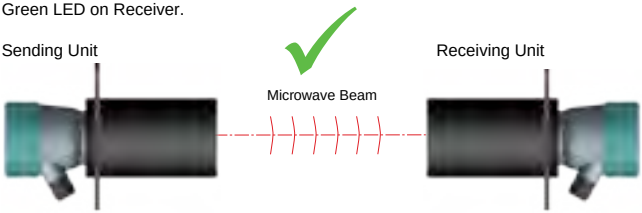
Mounting of a Microwave system on **sloped vessel walls** can be accomplished using the Microwave Adjustable Mount (MA-12 or MA-13). This system allows the microwaves to be mounted to a sloped surface and then adjusted horizontally for optimum performance and operation. The adjustable mount has an integral 4" weldment with UHMW polyethylene or PTFE (Teflon) window options. An option with the bracket is a vibration isolation kit (shock mounts) to help protect the electronics from damage. Each side wall of the vessel must not exceed 30 degrees from the vertical centerline. To mount the adjustable bracket, simply cut a hole and weld the 4" weldment directly to the vessel, install the window, mount the microwave and adjust horizontally.



Correct Mounting Angle

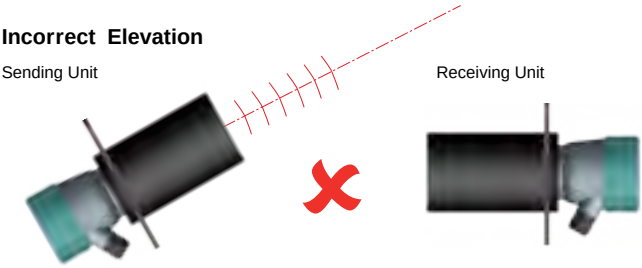
Correct Elevation

Maximum Signal Strength to Receiver is indicated by maximum brightness of Green LED on Receiver.



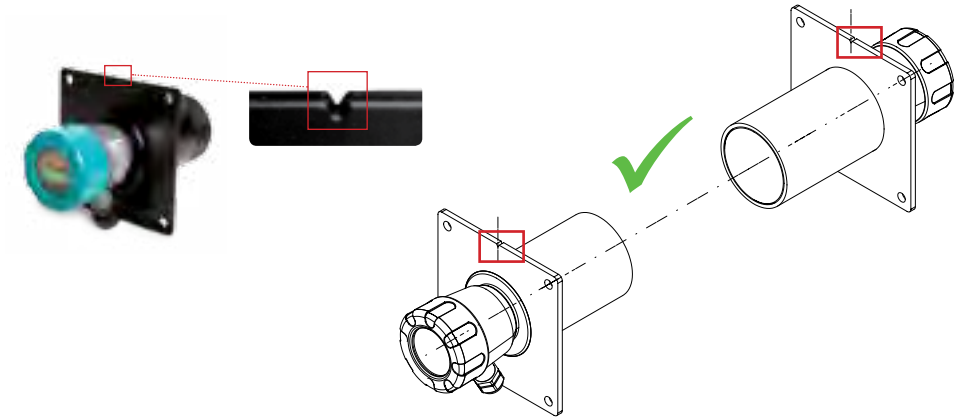
Housing can be rotated within 200º after the mounting thread is tightened, to allow cable entries to face downwards or allow optimal cable clearance.

Incorrect Elevation



Align Sender and Receiver

Rotate so that Visual Alignment Guide is in the same position on both sender and receiver.



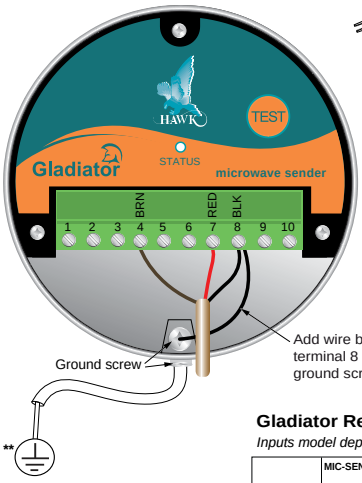
Remote System Connection - HAWK Supplied Cable

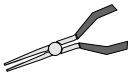
- The black wire of HAWK supplied cable comes with one end GND and the other GND / SHLD together.
- The GND / SHLD end is a larger cable which has been heat shrunk. The GND only end is the same size as the other cables.
- The GND / SHLD end must be connected to the amplifier.

Sender / Receiver
(GND only end)

Amplifier
(GND / SHLD end)

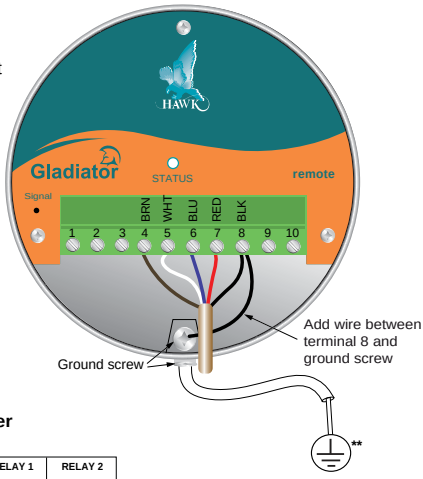
Remote Sender





Use long nose pliers to extract terminals

Remote Receiver



Gladiator Remote Amplifier

Inputs model dependent

			MIC-SENDER							RELAY 1			RELAY 2													
			RED	BLACK	BROWN	SLAVE IN	MASTER OUT	TEST IN		NC	COM	NO	NC	COM	NO											
16	17	18	19	20	21	22	23	24		25	26	27	28	29	30											
			Sender																							
1	2	3	4	5	6	7	8		9	10		11	12		13	14	15									
Is	+	–	RED	BLACK	BLUE	WHITE	BROWN		B	A		–	+		⏚	N	L1									
4-20mA			SENSOR						COMMS			DC-In			AC-In											

Remote Receiver

**Ground the housing to vessel if vessel is metallic. Ground the housing to plant ground if vessel is non-metallic.

Remote Sender

Status LED

- Green when powered
- Blinks while working correctly
- Solid while not transmitting

TEST Button

- Press and hold to test level relay action

Remote Receiver

Status LED

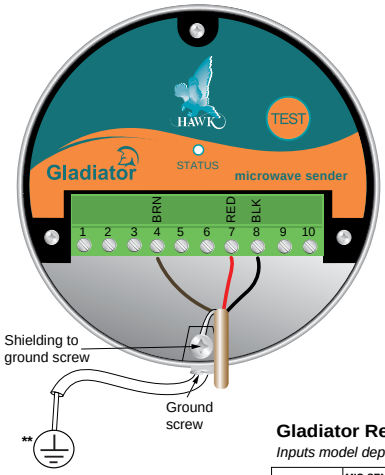
- Green when powered
- High illumination = strong signal
- Low illumination = weak signal

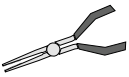
Signal Contact

- Signal can be read with voltmeter across Signal contact point and earth screw (or other ground reference)
- 2.4-2.5V is full signal. 0V is no signal

Remote System Connection - Customer Supplied Cable

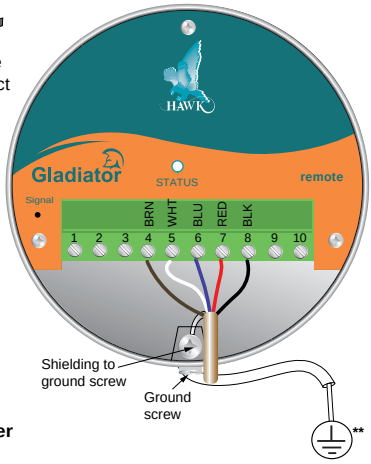
Remote Sender





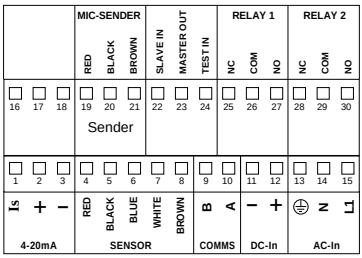
Use long nose pliers to extract terminals

Remote Receiver



Gladiator Remote Amplifier

Inputs model dependent



Remote Receiver

**Ground the housing to vessel if vessel is metallic. Ground the housing to plant ground if vessel is non-metallic.

Remote Sender

Status LED

- Green when powered
- Blinks while working correctly
- Solid while not transmitting

TEST Button

- Press and hold to test level relay action

Remote Receiver

Status LED

- Green when powered
- High illumination = strong signal
- Low illumination = weak signal

Signal Contact

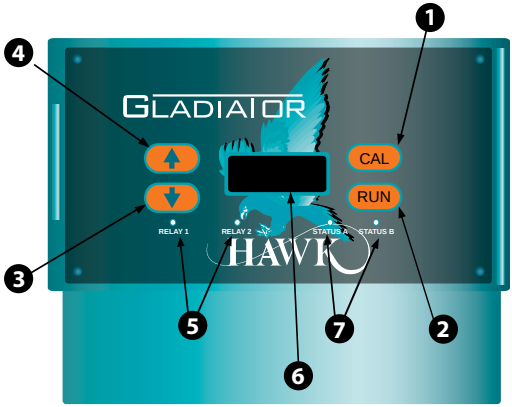
- Signal can be read with voltmeter across Signal contact point and earth screw (or other ground reference)
- 2.4-2.5V is full signal. 0V is no signal

Alternate cable type between Amplifier and Sensors

- 6 or 8 conductor (5 used) shielded twisted pair instrument cable.
- Conductor size dependent on cable length.
- BELDEN 3120A, DEKORON or equivalent.
- Max: BELDEN 3120A = 500m (1640 ft). 3 pairs, 1 conductor not used.

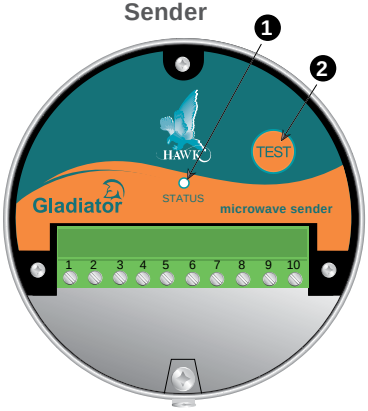
Alternate Cable Colour Equivalents			
Pairs	**HAWK**	**Belden 3120A**	**Dekoron**
Pair 1	Red Black	Red Black	White 1 Black 1
Pair 2	White Blue	Yellow Green	White 2 Black 2
Pair 3	Brown ---	Brown White (not used)	White 3 Black 3 (not used)
Pair 4	not used	not used	not used

Functionality Layout - Remote System

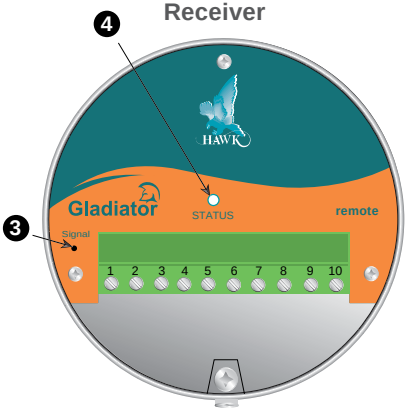


1. Calibrate button
2. Run button
3. Down button
4. Up button
5. Relay LEDs 1 and 2
6. Display (LCD with backlight)
7. Status LEDs A and B
   - **Status A** flashes with signal transmission of a unit in **Remote** or **Master** mode.
   - **Status B** flashes with signal transmission of a unit in **Master** or **Slave** mode.

Sender



Receiver



(1) Sender status LED

- Blinks while working correctly
- Solid while not transmitting
- Clear indicates no power

(2) TEST button

- Press and hold to test level relay action

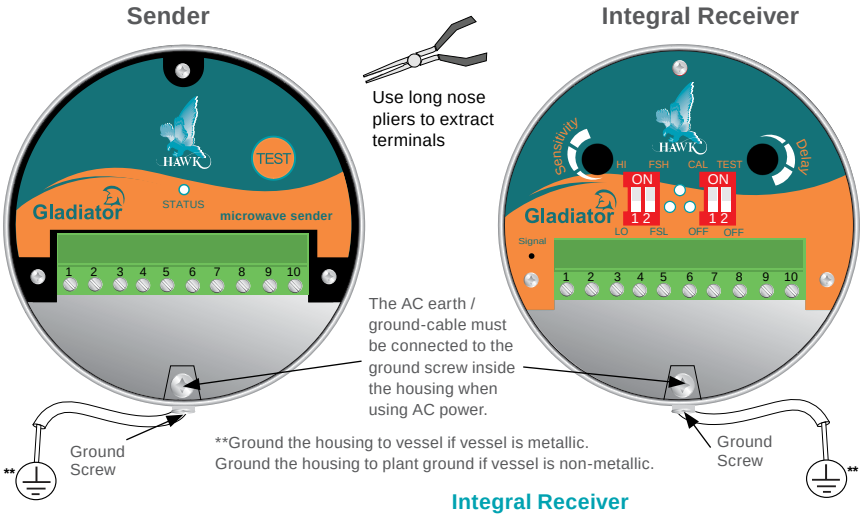
(3) Signal contact

- Signal can be read with voltmeter across Signal contact point and earth screw (or other ground reference). 2.4-2.5V is full signal. 0V is no signal.

(4) Receiver status LED

- High illumination for good signal
- Low illumination for weak signal
- Clear indicates no power

Integral System Connection


Sender
Integral Receiver
Use long nose pliers to extract terminals
HAWK
TEST
Gladiator
STATUS
microwave sender
1 2 3 4 5 6 7 8 9 10
sensitivity
delay
HI FSH CAL TEST
ON
LO FSL OFF OFF
Signal
The AC earth / ground-cable must be connected to the ground screw inside the housing when using AC power.
Ground Screw
**Ground the housing to vessel if vessel is metallic.
Ground the housing to plant ground if vessel is non-metallic.
Ground Screw

Sender

Status LED

- Green when powered
- Blinks while working correctly
- Solid while not transmitting.

TEST Button

- Press and hold to test level relay action.

SENDER TERMINAL LAYOUT

						DC-IN		AC-IN	
1.	2.	3.	4.	5.	6.	7. +	8. -	9. N	10. L1
						12-30VDC		80-260VAC	

Terminals 1, 2, 3, 4, 5, 6 not used

Integral Receiver

Status LED

- Green LED: Indicates received signal strength
- High illumination = strong signal
- Low illumination = weak signal
- Red LED: Indicates Relay status
- Blue LED: Flashes during calibration.
  Stays illuminated if calibration fails.

Signal Contact

- Signal can be read with voltmeter across Signal contact point and earth screw (or other ground reference)
- 2.4-2.5V is full signal. 0V is no signal.

RECEIVER TERMINAL LAYOUT

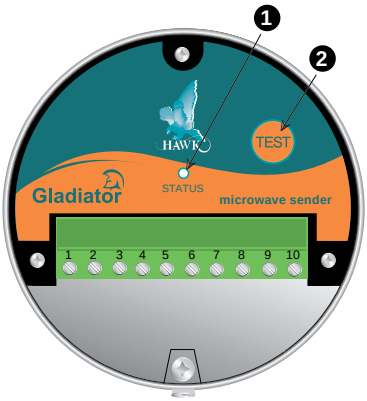
RELAY				COMMS		DC-IN		AC-IN	
1. NC	2. COM	3. NO	4. Test	5. A	6. B	7. +	8. -	9. N	10. L1
				RS 485		12-30VDC		80-260VAC	

Note:

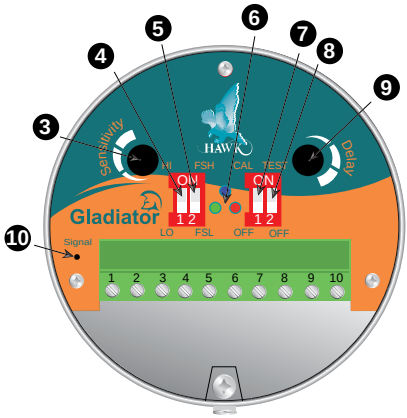
AC power terminals may only be used when universal AC power supply option has been selected - see part numbers - AC terminals have no function in products without universal AC power option.

Functionality Layout - Integral System

Sender



Receiver



(1) Sender status LED

- Blinks while working correctly.
- Solid while not transmitting.

(2) TEST button

- Press and hold to test level relay action.

(3) Sensitivity dial

- Turn clockwise for switching in clean environments and object detection.
- Turn counter-clockwise for difficult applications, dusty/ wet environments.

(4) Hi / Lo switch

- Hi mode for clean environments and object detection.
- Lo mode for difficult applications, dusty/wet environments.

(5) FSH / FSL switch

- FSH relay normally closed.
- FSL relay normally open.

(6) Receiver status LEDs

- Green - High illumination for good signal, Low illumination for weak signal.
- Red - Relay indication. Illuminated when closed.
- Blue - Cal mount indication - flashes during Cal mount, will stay illuminated if Cal mount fails.

(7) Cal Mount switch

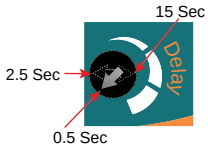
- Cal mount conducts the automatic setup routine for the system. Perform Cal mount for all new installations, and after adjusting either Sensitivity pot or Hi/Lo switch.
- Switch up to initiate Cal mount, wait several seconds, then switch back down. Unit will automatically complete Cal mount routine.

(8) Test switch

- Can be used for a failsafe / test relay. See full manual for further information.

(9) Delay pot

- Rotate clockwise to increase Relay on/off delay time.



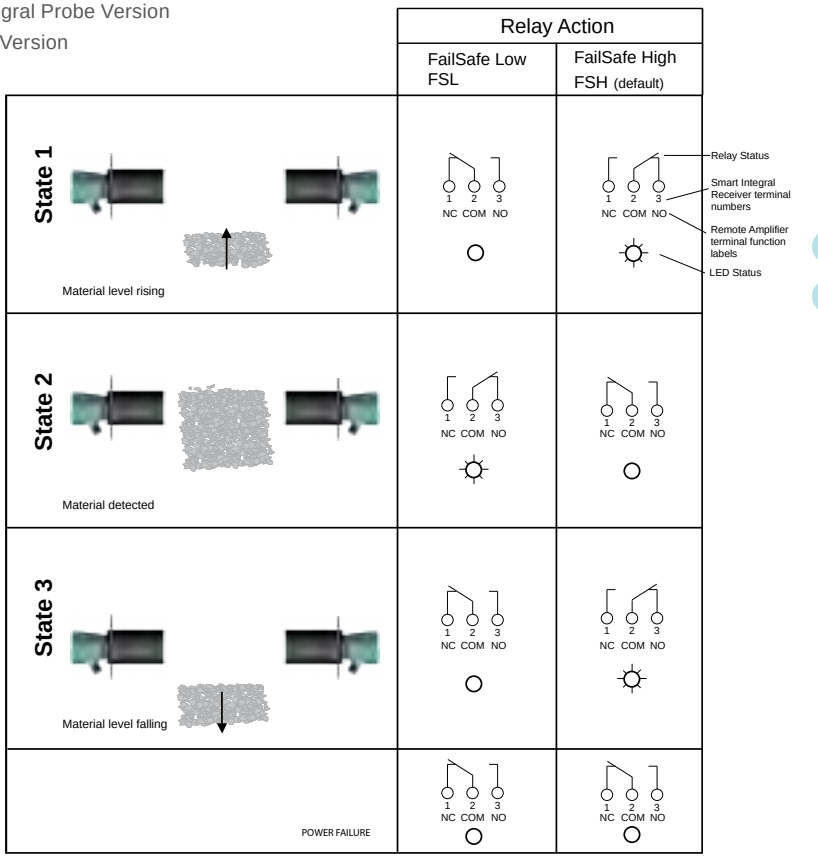
(10) Signal contact

- Signal can be read with voltmeter across Signal contact point and earth screw (or other ground reference). 2.4-2.5V is full signal. 0V is no signal.

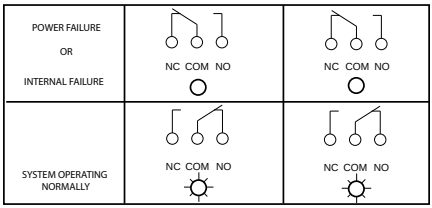
Wiring - Relay Functions

Switch contact actions.

Relay - for Smart Integral Probe Version
Relay 1 - for Remote Version



FailSafe Switch Contact Action
Relay 2 - Remote version only. For Smart Integral units, the Test terminal can act as a solid state output with a similar function.



Setup Procedure - Integral System

1. Mount the units according to Mounting Guidelines

1.1 If units are AC powered ensure proper grounding is connected to ground screw.

2. Make sure that the material or target is not blocking the path between sender and receiver.

3. Turn the power on

The green LED on the sender and receiver will stay on permanently to indicate that power is on. Green LED on receiver varies in brightness with strength of received signal.

4. Select the required relay action

The Relay can switch 'ON' (FSL) or 'OFF' (FSH) as the microwave beam is blocked. Set the relay action selection switch position depending on your requirements. FSH is recommended (ordinarily on/energised, switches off/DEN during blocked conditions).

6. Select the sensitivity

There are two adjustments controlling the sensitivity of the switch point:

6.1 The 'HI/LO' sensitivity switch is used as the primary sensitivity setting. Select LO sensitivity for Blocked Chute detection and if build-up is expected over sensors. Select HI sensitivity for clean environments and lighter/less absorptive material or targets. LO recommended for most applications.

6.2 The sensitivity dial

Turning the pot fully counter-clockwise factory recommended for blocked chute applications. If operating in HI mode set the pot to 12 o'clock. In this mode you can turning the pot clockwise to reduce the amount of beam blockage required for switching and vice versa.

7. Select the relay time delay

Full anti clockwise is minimum (0.1 seconds). Full clockwise is maximum (20 seconds). Adjust as required allowing time to avoid possible nuisance trips. The selected delay will be used for both an ON delay and an OFF delay.

8. Perform a CAL mount

Do not proceed with this step unless the material or target position is well beneath the line between the sender and receiver.

Switch CAL switch on the Receiver unit to ON position. The Blue LED will blink to indicate that mounting calibration is now in progress. Wait 5 seconds, then switch the mounting calibration switch to 'OFF' position.

The blue LED will switch off after successful calibration. If it stays on this indicates there was a calibration error. If this is the case please check that the path between sender and receiver is clear and alignment is correct. You may need to lower the Sensitivity setting. Try the calibration again. If mounting calibration was successful the blue LED should be off and the Green LED should be ON.

9. Switch check

If required block the Sender with a sample of the application material (note the units are capable of penetrating significant amounts build up). The green LED will dim when the Microwave beam begins to be blocked.

You can also press the 'TEST' button on the Sender to simulate a blocked chute condition and thus trigger the relay action.

Note: Integral type Microwave systems should not be used for anti collision detection / boom protection applications where there is limited access to the electronics. Contact Hawk for information about the remote type systems.

Setup Procedure - Remote System

1. Mount the units according to Mounting Guidelines

To protect from surges, ensure that an external ground wire is connected between the outside ground screw on the Gladiator housing and the vessel or other ground source.

2. Make sure that the material or target is not blocking the path between sender and receiver.

3. Choose Application Type (App Type)

Selecting the App Type sets the unit to pre-sets specific for blocked/plugged chute detection, boom protection (long range machinery collision detection) and several others.

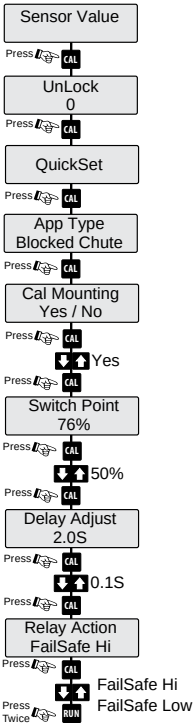
A) Alignment - For aligning the unit at long range. Unit is set to 1.2V signal (~48% switch value on display), move the unit face to get the volt reading high (2.4V will be the maximum reading or 0% switch value). Calibrate & re-select this mode and repeat till you cannot improve the alignment.

B) **Blocked Chute** - Configures the unit for blocked chute applications.

C) Boom Protection - Configures the unit for anti collision applications

D) Switch - Allows selection of Sensitivity% for typical level switch application. The higher the programmed %, the more responsive the unit will be. Use a lower % if build up or dusty conditions are expected.

E) Analog (Density) - Special measurement mode. See App Types for further information.



4. Perform Cal Mount

Some App Types require a Cal Mount. This calibrates the system to ignore any interference caused by mounting etc. There should be clear path between the sender and receiver.

Select 'Yes' to start the mounting calibration. 'Wait' will be displayed during the calibration for up to 30 seconds. Unit is now able to cancel the influence of the mounting. The % reading on the back lit display will be zeroed with the existing process conditions and the measurement history log has been cleared.

Always calibrate the unit after adjusting the App Type.

5. Select Switch Point

The output relay will switch when the Switch% exceeds the entered value. The default value of 76% will be suitable for detecting most media. For detection of products which are less absorbent of Microwave energy, select a lower % value and vice versa. For highly absorbent materials, almost any setting will work, but higher % settings will be more immune to build up. When the level or target falls below the sensors the relay will switch back at half of the entered switch point % value (when the beam is no longer broken).

6. Set Delay

Set the time delay to be used for both switch on and switch off action.

7. Choose Relay Action

The Relay can switch 'ON' or 'OFF' as the microwave beam is blocked and switch 'ON' or 'OFF' in response to an instrument failure. Failsafe Hi for normally closed relay, failsafe Low for normally open relay.

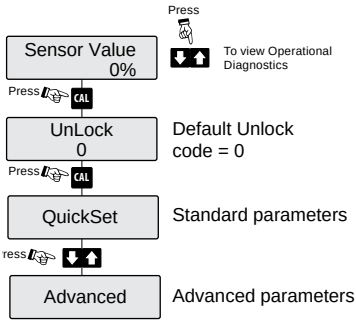
Note: Older software revisions may have different parameters or menu structure

Operational Diagnostics

Diagnostic	Description	Notes
Sensor Value	Sensor value indicates the amount of signal blocked from 0-100%. 0% is full signal, 100% is complete blockage.	
SW On	For the level relay to switch to state '2', the Sensor value must exceed this SW On % for the duration of the on delay time.	
SW Off	For the level relay to switch to state '1', the Sensor value must drop below this SW Off % for the duration of the off delay time.	Switch mode 'Auto' will automatically set the SW Off % to 2/3rds of SW On %
Max	The maximum recorded Sensor value % since last log reset	
Min	The minimum recorded Sensor value % since last log reset	
Delay	Dynamic switch delay time indication	
Temp	Measured temperature inside Receiver unit	
• Normal • Recover • Failed	• Unit in normal operation • Unit applying 'Recover' Gain to retain or enhance signal • Unit is in failsafe condition	Unit will indicate Recover commonly for blocked chute and other switching applications.
Signal	Signal strength measured at the Receiver. This value is proportionate to the Sensor Value %: • 0V = Sensor Value 100%. No Signal • 1V = Sensor Value 50%. Half Signal • 2.0V = Sensor Value 0%. Full Signal • 2.0V to 2.5V = Sensor Value 0%. Full signal	In most modes the unit will be looking to hold a 2.5V signal. 2.0V to 2.5V is used for signal stability purposes.
Recover	Recover Gain % applied. Recover Gain is used retain the incoming signal during difficult conditions.	The programmed App Type will have pre-defined amounts of Recover Gain available.
Gain	Gain % applied. This is the total Gain (Calibrated Gain plus Recover Gain) applied by the system.	
Noise	Noise interference in V - Noise from interfering received frequencies or along the communications wiring.	It is normal to see a small consistent amount of Noise.
• Remote • Master • Slave	• Remote: (default). Standard remote system • Master: Unit mode is set as 'Master' for cross-talk prevention • Slave: Unit mode is set as 'Slave' for cross-talk prevention	

Remote Main Menus & Interface - Remote System

Note: Parameters may vary depending on older software revisions



CAL **Select / Edit / Save**

RUN **Run / Return**

Scroll up / down

Quickset Menu - Parameters

Parameter	Description	Options
App Type (see next page for additional information about Application Types)	Select application pre-set. This automatically configures the unit to the recommended settings for each specific application. *Note: you must perform a Cal Mount after changing or selecting App Type*	• 4-20mA (Density) • Switch • Boom Protect • Blocked Chute • Alignment
Cal Mounting	Performs a Cal Mount in which the unit automatically configures itself based on the selected App Type and the mounting environment.	• Yes / No
Switch Point	This is the switch on / off sensor value % for relay actions	• Auto - 75% (on) 50% (off) • Manual (set in Advanced)
On Delay Adj	Set on delay time for the first relay. If using the 2nd relay in cleaner / maintenance mode 1/2 of this value will be the duration of the relay timer	• Adjustable in seconds
Relay1Action	Adjust the Relay action to be energised or de-energised during normal operation	• FailSafe Hi • FailSafe Low
Lock Code	Set a lock code to prevent unauthorised access	• Default 0

App Type - Parameters

App Type	Description	Sub Menu
Analog (Density) (see Density Setup Guide below)	Analog is the new App Type which allows customers to measure variation in the amount of Microwave energy blocked and absorbed by on application. The variance is represented by a 4-20mA analog output. *Note: Relay1 as a switch function is disabled while the Density application is selected.*	**HiSpan%** This is the 20mA reference point. This can be Viewed, Autoset or set to a Custom value. This value will always be a 10-100% with 10% the most sensitive 100% suited to measure the indicate the widest variation.
Switch	Sets the unit to a standard switch mode with adjustable sensitivity	**Sensitivity%** A high value will make the unit more sensitive to switching and responding to lighter materials. A low value will make the unit more resilient and ignore dust / build up.
Boom Protection	Sets the unit to Boom Protection mode. This can also be used for machinery / truck or object detection & collision avoidance.	
Blocked Chute	Sets the unit for blocked chute mode. *Note: This mode may be unsuitable for very low dielectric materials.*	
Alignment	A mode to assist aligning units over long range. Select this mode and perform a Cal Mount. RUN the unit and it will indicate half signal / approximately 48 Switch% on the display. Improving the alignment will reduce the % with the goal to reduce as low possible. Re Cal-Mount if the % reaches 0 and continue to adjust the alignment until it cannot be improved further. After using this mode you must set the unit back to a normal app type as function is purely for alignment.	

Analog (Density) Setup Guide

1. Select '**Analog'** (Density) App Type
2. To set the **4mA** condition reference - Perform a **Cal Mount**. HAWK recommends this should be done with Clear Path between Sender and Receiver.
3. Press **RUN** several times to restart the unit.
   This will be the **4mA** reference point for the analogue
   Note: You must RUN the unit before proceeding with the next step

To set the **20mA** reference point you can either:

4. Enter a specific '**HighSpan%**' (10-100%) or;
5. Start the process you wish to measure. When the desired density of product is between the Sender & Receiver you can enter the Quickset menu and run '**Autoset**'. This sets the measured condition between Sender and Receiver to the **20mA / 100%** reference.
   If Autoset returns '**Failed**' you either did not press **RUN** after the **Cal Mount** to set the **4mA** point or the Microwave pulses are not blocked by a high enough density which the unit can detect.

Advanced Menu - Parameters

Parameter	Description	Sub Menu
Switch Mode	• Auto - Switch On% set in Quickset, Switch Off% automatically configured • Manual - Manually adjust Switch On and Switch Off % • Off - Switch mode disabled in Analog (Density) mode	• Switch On% • Switch Off%
Relay2Action	Set Relay2Action as one of the below: • **Failsafe** - Relay2 triggers on failsafe conditions • **Relay2** - Mirrors Relay1 action to act as a second / backup relay for the system • **Maintnce Chk*** - Triggers Relay2 at a pre-defined Gain value for a maintenance / build up alarm • **GainOPpt Cln*** - Triggers Relay2 to activate a cleaner system based on total Gain used • **TimeOpt Cln*** - Triggers Relay to activate a cleaner system based on a programmed time delay	** For further information about the Maintenance and Cleaner Relay2 alarms see 'Relay 2 Actions' on next page*
View Log	Sets the unit to Boom Protection mode. This can also be used for machinery / truck or object detection & collision avoidance	
Reset Log	Sets the unit for blocked chute mode. Note that this mode may be unsuitable for very low dielectric materials.	
Comms Type	Adjust & select additional communications, baud rate and device ID. All GSA units by default include Modbus.	• DeviceNet (not functional) • Profibus (not functional) • HART (not functional) • Modbus
Back Light	Turn on / off LCD backlight	
Operating Mode	• Remote: Default setting for standard remote system • Master: Set system to Master mode for 2 system anti-crosstalk • Slave: Set system to Slave mode for 2 system anti-crosstalk	For further information see 'Cross Talk Prevention / Sequencer Wiring' section
Display Span		
Probe Avg	Probe Avg is a output damping parameter. Increase to smooth out unwanted fluctuations or instability.	
LoadDefaults	Reset system to defaults (amplifier and/or sensor)	
InputVolChk	Used for power related failsafe. When active the unit will switch to failsafe mode if input voltage drops below required power. When not active unit will display 'Input Voltage too low' on the display if input voltage drops below required power.	

Relay 2 Actions

Maintenance & Auto cleaner functions

- The Gladiator Amplifier can use **Relay 2** as a trigger mechanism to notify the user or activate a cleaning system based on time or conditions within the application which require cleaning/maintenance.
- There are three software options using two different concepts. The first concept is based on total **Gain** used and the second is based on a **Time interval**.

The selectable software options are as follows:

[Maintnce Chk]

- The unit will switch on the relay when total **Gain** is greater than the **CleanGainHigh** % - the relay will switch off when **Gain** falls below **CleanGainLow** %.

[GainOpt Clng]

- When total **Gain** exceeds the **CleanGainHigh** point the unit activates the relay for 1/2 of the **On Delay** time and then switches off.
- The unit will then count the **Clean Time interval** time before repeat the process until total **Gain** is below **CleanGainLow** point.

[TimeOpt Clng]

- At every **Clean Time interval** the unit will switch on the relay for 1/2 of the **On Delay** time and then switch off.

Other Relay2 Actions

- **Relay 2** - Sets the 2nd relay to mirror the first relay action
- **Failsafe** - Sets the relay to trigger for a failsafe condition such as sender/receiver fail or voltage problem

Setup Example - Time Based

- In '**Quickset**' Set '**On Delay**' to 4.0 seconds - this will provide a 2.0 second water blast.
- In '**Advanced**' set '**Relay2Action'** to '**TimeOptCln**' with a '**Clean Timer'** of 30min.
- Every 30 minutes the sensors will be sprayed for 2 seconds.

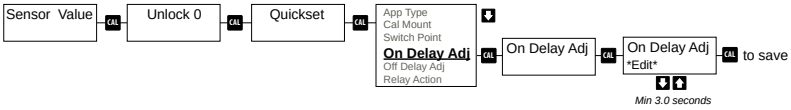
Setup Example - Gain Based

See next page for Software flow chart.

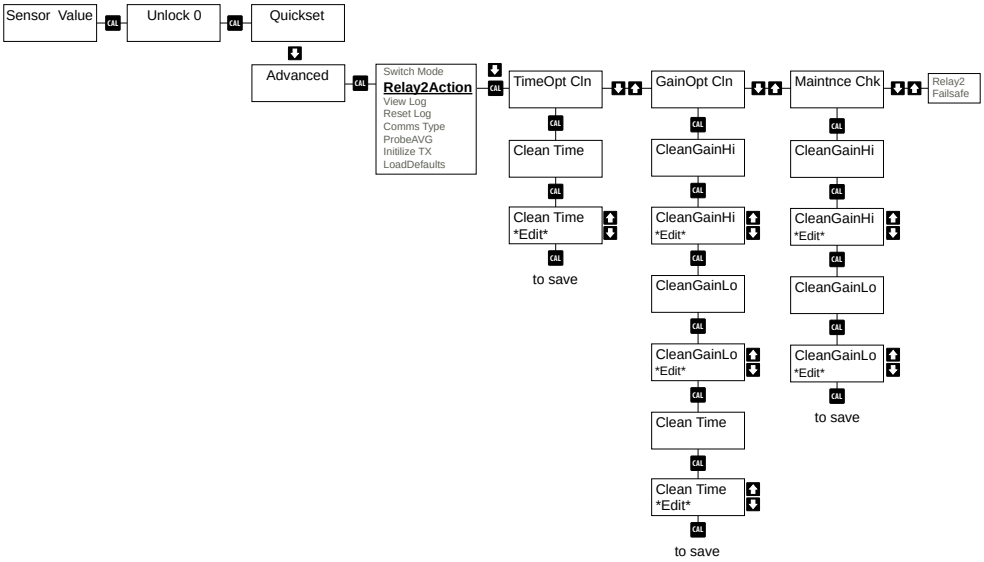
- In '**Quickset**' Set '**On Delay**' to 4.0 seconds - this will provide a 2.0 second water blast.
- In '**Advanced**' set '**Relay2Action** to '**GainOptCln**' with a '**CleanGainHi**' of 80%, '**CleanGainLo**' of 70% and '**Clean Timer**' to 5.0min.
- This will trigger the water spray for 2 seconds when **Gain** goes above 80%. The spray will repeat every 5 minutes until **Gain** goes below 70%.
- You can view **Gain** while the unit is running by using the arrow key to locate the diagnostic display.

Relay 2 Software Flow Chart

To set spray duration for Gain and Time options (1/2 of On Delay).



To set Relay 2 action for one of Time, Gain or Maintenance options.



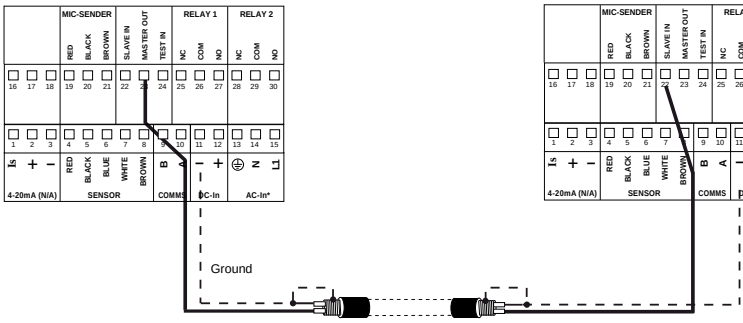
Cross-Talk Prevention / Sequencer Wiring

- Up to four remote Microwave systems can be set up for anti-crosstalk.
- For two systems, one can be set to operating mode ‘Master’ and the other to operating mode ‘Slave’.
- For up to four systems, a dedicated Sequencing control unit must be used with the four systems set to operating mode ‘Slave’.
- See user manual for further information.

Master / Slave Wiring

GLADIATOR MICROWAVE REMOTE AMPLIFIER - MASTER

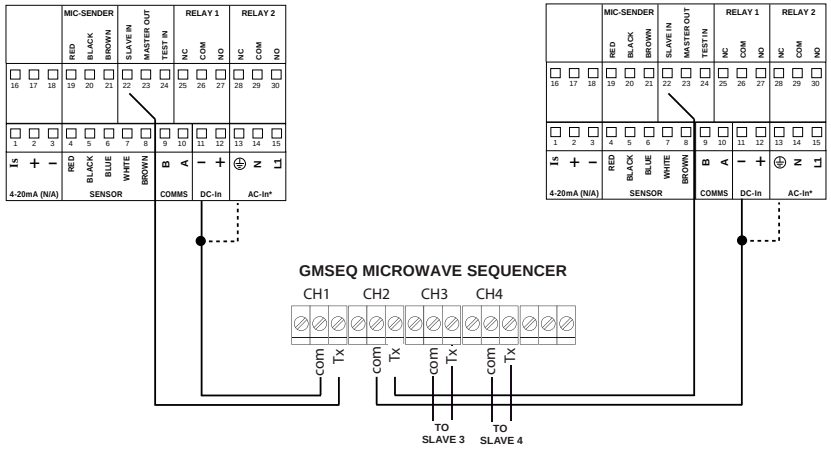
GLADIATOR MICROWAVE REMOTE AMPLIFIER - SLAVE



Sequencer / Slave Wiring

GLADIATOR MICROWAVE REMOTE AMPLIFIER - SLAVE

GLADIATOR MICROWAVE REMOTE AMPLIFIER - SLAVE



Integral Receiver Test Switch Functions

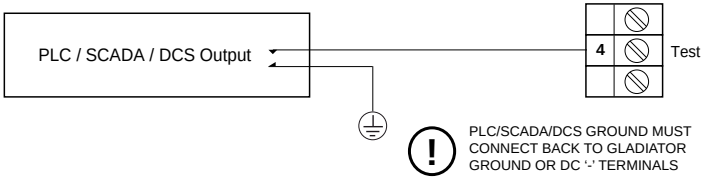
The test terminal has two potential modes of operation for Integral units and always operates in the test input mode for Remote units. Remote units have a separate, failsafe relay contact, which is always functional.

Test Input Mode

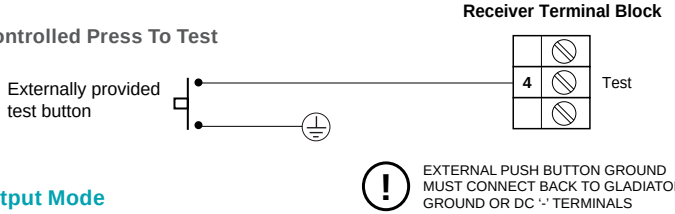
Test Switch: ON

Test terminal acts as an input for remote testing of the instrument's switching function. Used to check for malfunction of unit from a remote position, PLC, SCADA etc.

Test Input from PLC/SCADA/DCS Digital Output


Receiver Terminal Block
PLC / SCADA / DCS Output
4
Test
PLC/SCADA/DCS GROUND MUST CONNECT BACK TO GLADIATOR GROUND OR DC '-' TERMINALS

Operator Controlled Press To Test

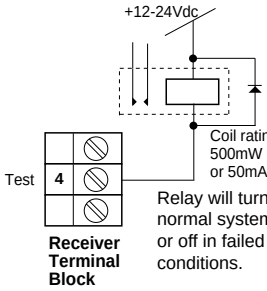

Receiver Terminal Block
Externally provided test button
4
Test
EXTERNAL PUSH BUTTON GROUND MUST CONNECT BACK TO GLADIATOR GROUND OR DC '-' TERMINALS

Failsafe Output Mode

Test Switch: OFF

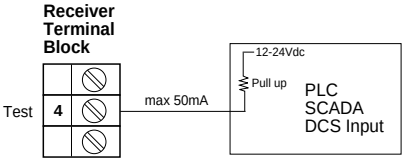
Test terminal will provide an output which is able to switch an external failsafe relay or PLC/SCADA/DCS input. During normal system operation this terminal will internally switch a solid state (transistor) output to ground (or DC '-'). If power fails or an internal system failure occurs, the terminal will act as an open circuit.

To switch an external relay



Relay will turn on during normal system operation or off in failed or unpowered conditions.

To a PLC input



Input will detect '0' state during normal system operation, or '1' in failed or unpowered conditions.

Troubleshooting

Erratic / non responsive Sensor% value

- For older hardware, ensure the Sender is set to the correct mode via switch on facia (INT for Integral, REM for remote).
- Press and hold the 'Test' button on the Sender unit. This will force the Sensor % to read 99-100%. If this functions correctly the system is operating correctly.
- If the system is operating correctly increase 'Probe Avg' to create a smoother displayed value.
- There may be build up or signal loss if the unit is not able to hold a 0% value this indicates signal loss or not enough Gain is available. Check for build up, obstructions, or choose a new App Type / perform new Cal Mount.

If the system does not respond to pressing the 'Test' button

- There may be a potential hardware fault.
- First confirm wiring runs are correct (see Error 01 codes for further information on wiring checks).
- Change the Receiver, Sender, Amplifier in this order. If this does not resolve the issue, remove hardware and perform isolated bench test on the units.

Switch Testing

- If the Sensor% reads 0% this means full signal is present and the system is operating correctly. Use the 'Test' button on the Sender to test the relay action.

Manual blockage switch testing

- In some modes the Hawk Microwave system will be difficult to switch test using small objects. You must completely cover the Sender and Receiver with solid materials (such as bags of process material).
- You can also view the 'Recover Gain' Diagnostic which will respond while the signal begins to be blocked by objects.

Relays & LCD intermittently dimming and dropping out.

- Check incoming voltage with a multimeter in line. Confirm it is as per Specification
- If the unit is AC powered put a multimeter over the DC +/- terminals. The unit generates a diagnostic DC voltage in these terminals. If powered by AC. This should read at least 8V consistently.
- If this is unstable and dropping below 7V while your incoming AC is stable there is likely a problem with the internal power supply. Contact your local distributor or HAWK.

Error Codes

Error 01:

- Amplifier/Transmitter can not communicate with sender/receiver.
- Error No 01 is displayed on power up with a reset loop or after unit has successfully operated and subsequently failed.
- Check wiring terminals for a loose or incorrect connection (including junction box / cable extensions).
- Check the cables for any signs of damage.
- Ensure any customer supplied cable meets HAWK specifications.
- Ensure correct power is applied to the correct terminals. DC only version units will not support AC.
- Use a multimeter to check voltage supply for the Remote Sender & Receiver on the red/black labeled terminals of the Amplifier. You should get approximately as below:

Sender 24.0VDC
Receiver 9-10VDC

- Disconnect Sender and Receiver from amplifier and use a multimeter to check kohm resistance values (approximate) across the following wires.

Sender:

- Brown: Black 200-230kohm

Receiver:

- White: Blue 27-32kohm
- Black: White or Blue 13-16kohm
- Brown: Blue or White 70-80kohm
- Brown: Black 60-70kohm

Error 02:

- Error Codes can also indicate communication data failures or corruption between Amplifier and Sender/Receiver.
- Ensure any junction box / wiring extensions are as per Hawk wiring guide. Make sure wiring is correct especially look to the screen (earth).

Error 03:

- Incorrect comms module selected (eg Profibus, FF). Check part number to confirm communications options (All units are Modbus as default)

Error 04:

- Amplifier is programmed with incorrect software. Contact your local support.

FCC Regulations

Qualifications

The Federal Communications Commission imposes strict requirements on radiating sources such as the GSA, GMS, GMRR, GMSR, Microwave Systems.

This unit is tested to, and meets these requirements, which include operating frequency and stability, harmonic and spurious generations and power output.

The HAWK Gladiator Microwave System complies with FCC Rules Part 15 for industrial controls. No licenses or approvals are required to use the system.

Requirements

(A) OSHA - 10mW/cm2of radiated power.

(B) ANSI - 5mW/cm2 of radiated power.

The Hawk Gladiator Microwave Systems have approximately 20µW/cm2 of radiated power.

Note: The HAWK Microwave Pulse Systems are well below the stringent safety standards required by both the above governing bodies. It is regarded as a SAFE level control and may be used with no special precautions.

Remote Version

Remote Amplifier

GSA Gladiator Amplifier (compatible with all Gladiator products), Modbus

Housing
S Polycarbonate

Power Supply
B 12-30 VDC
C 30-48VDC and 48-90VAC
U 12-30VDC and 90-260VAC

Output Options
S 2 Relays (relay 1 primary switch, relay 2 secondary switch OR Failsafe / Cleaner / Maintenance alarm)
X Option 'S' plus 4-20mA output

Approval
A22 ATEX Grp II Cat 3 GD T85°C IP67 Tamb -40°C to 70°C

GSA	S	U	S

Remote Sender / Receiver

GMSB Gladiator Microwave Sender
GMRR Gladiator Microwave Remote Receiver

Frequency
1 10.525 GHz

Transducer Facing Material Selection
0 UHMW Polyethylene
1 PTFE Teflon

Transducer Housing Material
1 Aluminium / Mild Steel
2 316L Stainless Steel

Output Option
X Not Required - Outputs generated from GSA amplifier

Approval Standard
X Not Required
A22 ATEX Grp II Cat 3 GD T85°C IP67 Tamb -40°C to 70°C

GMSB	1	0	1	X	X

Connection Cable

CA-GMR Pre-cut cable for remote sender or receiver

10 10m cable
20 20m cable
30 30m cable
50 50m cable
100 100m cable

CA-GMR	10

Lengths above 100m available via special order

Integral Version

GMS Gladiator Microwave Sender
GMSR Gladiator Microwave Smart (Integral) Receiver

Power Supply
B 12-30 VDC
U 12-30VDC and 90-260VAC

Frequency
1 10.525 GHz

Transducer Facing Material Selection
0 UHMW Polyethylene
1 PTFE Teflon

Transducer Housing Material
1 Aluminium / Mild Steel
2 Full stainless steel

Output Option
X Not Required for Sender units
S Switch, 1 output relay with Modbus for Receiver units

Approval Standard
X Not Required
A22 ATEX Grp II Cat 3 GD T85°C IP67 Tamb -40°C to 70°C

GMSR B 1 0 1 S X

HAWKLink Modem

Model
HL HAWKLink

Type
R Remote stand alone system

Power Supply
B 12-30VDC
U 12-30VDC and 90-260VAC

Network Type
G3 3G

Simcard
S3 Australian Simcard expires after 3 month
S12 Australian Simcard expires after 12 month
X Not Required (customer supplied data enabled simcard)

HL R U G3 S3

MA Mounting Accessory

Type

0	3” Weldment, each
3	3” UHMW Window & Weldment each
4	4” UHMW Window & Weldment each
5	6” UHMW Window & Weldment each
6	3” PTFE Window & Weldment each
7	4” PTFE Window & Weldment each
8	6” PTFE Window & Weldment each
9	9’ x 4,5” fire brick assembly each
10	6” x 4” ceramic brick assembly each
11	Shock/vibration insulation mounts pack of 4
12	Adjustable mounting bracket (UHMW window) each
13	Adjustable mounting bracket (PTFE window) each
15	Flanged Focaliser tube (extension pipe) (mild steel)
16	3” Ceramic Window & Weldment each
17	4” Ceramic Window & 4” Weldment each
18	4” Microwave Weldment only each
19	3” Stainless steel Weldment only for UHMW each
20	4” UHMW Window only each
21	3” UHMW Window only each
22	4” Stainless steel Weldment only for UHMW each
25	Flanged Focaliser tube (extension pipe) (316L)
20-P1	4" UHMW Window with 40mm insertion depth (fits 4" Weldment)

MA 4

GMSEQ Gladiator Microwave Sequencer

Power Supply
B 12-30VDC
C 30-48VDC and 48-90VAC
U 12-30VDC and 90-260VAC

GMSEQ U

HAWKlink-USB HAWKlink USB PC connector for GosHawkII

Operating Voltage

- Integral 12-30VDC / Remote 12-30VDC (residual ripple no greater than 100mV)
- Integral 80-260VAC / Remote 90-260VAC 50 / 60Hz.

Power Consumption

- <0.8W @ 24VDC
- <3VA @ 115VAC
- <5VA @ 240VAC

Communications

- GosHawk, Modbus
- 4-20mA
- Multidrop mode can address 1-250 units over 4 wires.

Relay Output: (1) SMART (2) Remote

- Form 'C' (SPDT) contacts, rated 5A at 240VAC resistive
- Remote fail-safe test facility for one relay.

Operating Temperature

- Remote electronics -40°C (-40°F) to 80°C (176°F)
- Integral Units -30°C (-20°F) to 65°C (150°F)*
- Remote Sensors -30°C (-20°F) to 65°C (150°F)*.

**For higher temperature applications, remote mounting with refractory windows is necessary.*

Power Density

- Rated from emitter to receiver at approximately 20μW/cm²
- Complies with FCC Title Rules Part 15 (Beam Blockage)
- Caution sign posting not required.

Transmitted Signal

- Circular transmission polarity
- Frequency: 10.525GHz
- Power: +20dBm/100mW
- Sensitivity -95dBm
- Beam width 25º

Fail-Safe

- Selectable - presence or absence of material
- High level fail-safe: relay is activated when material is present
- Low level fail-safe: relay is activated when no material is present.

Range

- Maximum range under ideal conditions: 1200m (656ft)
- Minimum range under ideal conditions: 10cm (4 inches).

Note: Minimum ranges are dependent on application conductivity.

Sender / Receiver to Amplifier Separation

- Up to 500m (1640ft) using specified extension cable.

Alternate cable type between Amplifier and Sensors

- 6 or 8 conductor (5 used) shielded twisted pair instrument cable
- Conductor size dependent on cable length
- BELDEN 3120A, DEKORON or equivalent
- Max: BELDEN 3120A = 500m (1640 ft). 3 pairs, 1 conductor not used
- Max: DEKORON IED183AA004 = 350m (1150 ft). 4 pairs, 3 conductors not used.

Maximum Operating Pressure

- 2 BAR

Display (Remote version only)

- 2 line x 12 character alphanumeric LCD
- Backlight standard.

Memory - Remote

- Non-Volatile (No backup battery required)
- >10 years data retention.

Enclosure Sealing

- Integral Sensors IP67
- Remote Electronics IP65 (NEMA 4x)
- Remote Sensors IP67.

Cable Entries

- Remote Sensors: 1xM20 Gland / 3/4" NPTF threaded adaptor
- Remote Amplifier: 4x20mm (0.8"), 1x16mm (0.6") knock outs
- Integral Units: 2xM20 Glands / 3/4" NPTF threaded adaptors.

Mounting

- 3" male NPT thread or four 10mm (0.4") holes in flange
- MA12 / MA13 adjustable mounting bracket

Environment Seal

- 3", 4" and 6" weldments for standard mounting on vessel wall with PTFE and UHMW windows
- Flange for mounting separate from vessel wall - isolation shock mounts are available
- Ceramic window assemblies
- Firebrick window assemblies available on custom basis
- Waveguides - custom assemblies available for high temperature and limited access applications.

Weight

- GSA 1kg
- GMS 5kg
- GMR 5kg

HAWK, Since 1988

Hawk Measurement Systems Pty Ltd (HAWK) was established in 1988. It's founding members saw the universal requirement of various industries requiring improved process control and efficiency in their operations.

We Can Help

HAWK understands the difficulties customers face when seeking accurate level measurement. Every application is different, involving a multitude of environmental factors. This is where HAWK excels. Our aim is to ensure that customers not only feel comfortable with our technology, but also to ensure a consistent and reliable solution is in place for the long term. We believe that a combination of application and product expertise, as well as forward thinking and proactive support policies are the foundation of successful customer-supplier relationships.

Progressive Technical Support

HAWK believes that the future of the Level Measurement Industry revolves around the quality of pre and post sales - support. Our aim is for all sales & support staff to be product experts, and more importantly application experts making our customers applications as efficient and consistent as possible.

Remote Innovation

HAWK understands the need for immediate technical assistance.

The HAWKLink 3G communication device allows any computer with internet access and our free GosHawk diagnostic & calibration software; to dial in, calibrate, test, and check the performance of HAWK products. This innovative system allows our Global Support Team to assist with commissioning and after sales service of HAWK equipment worldwide. Measurement problems are addressed as they happen; not days or weeks later.

Knowledge Sharing

HAWK believes that knowledge sharing is key to creating long term relationships. Empowering our customers and our worldwide distribution network, whilst being available at all times to lend a helping hand, is the perfect recipe for long term solutions and relationships. HAWK openly extends an invitation to share our 25 plus years of level measurement experience, and ensure that your day to day processes are efficient, understood, and always working.

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